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## ABSTRACT

Experimental characterization of pulse propagation in the Beamlet laser system provides important quantitative verification of requirements for the NIF laser design. Recent results from the world's largest single aperture solid state laser will be presented.

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The National Ignition Facility is designed to ignite inertial-confinement fusion (ICF) targets using 1.8 MJ of ultraviolet (351 nm) laser light generated by frequency tripling the output of 192 neodymium glass laser beams. The Beamlet laser system is a full scale scientific prototype of one of the 192 NIF beamlines. With an output beam area exceeding 1,000 $cm^2$, Beamlet has the largest single clear aperture solid state laser beam in the world today. Since its initial activation in 1994, Beamlet has been used to validate design specifications and to explore the performance limits of the NIF laser system.

Because the estimated cost of the NIF facility is substantial ($1.1 billion) it is imperative that the performance be cost optimized. This implies operation as close as possible to power and energy extraction limits imposed by fundamental physical constraints. The quality of the far field focal spot is critical to target performance, and the quality of the near field determines how much energy can be transported to the target without damaging optical components.

Control of beam quality in the NIF and the Beamlet prototype is enhanced through the use of a deformable mirror which corrects large scale wavefront errors due to imperfections in the optics, air turbulence in the propagation path, and pump induced distortion of the laser amplifier slabs. Precorrection of the wavefront using a small aperture deformable mirror prior to injection into the main amplifier cavity has allowed us to produce a far field spot at the output of the transport filter that is less than 2x diffraction limited, with a Strehl ratio of $0.35 \pm .05$. Improved performance is expected later in 1996 when the small deformable mirror is replaced with a full 40-cm aperture intracavity deformable mirror, and with a new feedback system which allows us to maintain active control of wavefront correction up to less than 1 second before a shot.

Beamlet employs a sophisticated suite of laser diagnostic systems to measure beam quality. In FY'96 we have activated a new target Focal Plane Diagnostic (FPD) system to measure beam quality after frequency conversion from $1\omega$ (1.053 $\mu$m) to $3\omega$ (0.351 $\mu$m). Measurements of beam quality in recent $1\omega$ and $3\omega$ beam propagation experiments will be described. Beam propagation modeling using off-line measurements of the optical quality of individual components are compared with full system shot data to verify requirements for the quality of NIF optics. Results indicate that adequate optical quality of components can be achieved within NIF budget constraints.